MAN IN THE ARCTIC PROGRAM
Working Paper

Fiscal Consequences of Energy Resource Development

Planning for Government Services in Alaska

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THE MAN-IN-THE-ARCTIC PROGRAM

The Man-in-the-Arctic Program, funded by the National Science Foundation, is a long-range research effort intended to develop a basic understanding of the forces of change in Alaska and to apply this understanding in dealing with critical problems of social and economic development. The overall objectives to the program are to:

- Measure and analyze basic changes in the economy, the social conditions, and the population of Alaska.
- Identify significant interactions between outside economic and social forces and Alaska conditions and institutions.
- Analyze specific public problems associated with these interactions and policy alternatives for dealing with them.
- Assist planners and decisionmakers in solving critical problems of concern to both the state and the nation.

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FISCAL CONSEQUENCES OF ENERGY RESOURCE DEVELOPMENT:
Planning for Government Services in Alaska

INTRODUCTION

This paper reports on an effort to extend University of Alaska research in support of state budget planning and financial management. The Institute of Social and Economic Research Man in the Arctic Program (MAP), in cooperation with the National Bureau of Economic Research and the Harvard-MIT Joint Center for Urban Studies, has spent the last 5 years developing a comprehensive econometric model with endogenous fiscal and population links which is capable of simulating the long-range impacts of a broad range of fiscal and development policies, the results of which have been reported elsewhere.[1] Approximately 3 years of impact studies concerning growth and development in Alaska under a wide variety of assumptions has made it increasingly obvious to MAP researchers that all development projects proposed for Alaska which result in large revenue impacts are likely to have a negative impact on the state's fiscal position, if (1) new migrants to Alaska have approximately the same distribution of social characteristics as past migrants, and (2) new migrants require approximately the same level of state spending per capita as past migrants. The problem is not trivial, since the State of Alaska is currently heavily dependent upon oil and gas severance taxes to finance current operating expenditures, and the state administration and a significant number of legislators would like to reduce this dependence. On the other hand, our research has shown that if constant real per capita expenditures are assumed, and if migration is not controlled, then development projects would typically result in larger increases in expenditures than increases in revenues. Thus, attempts to improve the State's fiscal picture could cause it to deteriorate.

This apparent paradox is caused by the fact that the current level of state expenditures per capita is beyond the revenue-producing capacity of the state, aside from the petroleum industry. Thus, when these levels are projected into the future and coupled with the migration response to development, estimates of "required" state expenditures are larger than the state revenues, direct and indirect, induced by the project. Since Alaska is a marginal competitor for most industries, given distance from markets and the costs of labor, it does not appear that the solution to the state's fiscal dilemma lies in heavier taxation of new industry; nor, since Alaska's personal income tax rates are already among the highest in the nation, does political wisdom suggest that increasing the state's personal income tax rates is the solution.

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[1] A brief description of the MAP models may be found in Kresge [8]; Kresge and Seiver [9]; Kresge, Morehouse, and Rogers [10]; and in the applications listed below. Growth rules for state expenditures are discussed in Kresge and Seiver [9], while some fiscal options for use of the state's oil revenues are explored in Goldsmith (1977a) [1] and Goldsmith (1977b) [3]. Economic impacts of various development options are examined in Scott (1975) [11]; Goldsmith, et al. [7]; Scott (1976) [13]; Scott (1977) [12]; Goldsmith (1978a) [2]; Goldsmith and Huskey [6]; Goldsmith (1978b) [5]. The Man in the Arctic Program economists will produce a summary book-length report on the econometric models and applications for professional audiences in the fall of 1979 (tentative title: Public Policy and Regional Development). The manuscript is now in preparation.

If the prospects for finding new sources of oil revenues to sustain state expenditures are uncertain, and they are, one useful question is: what are the prospects for changing the level or rate of growth of state expenditures in Alaska? The preliminary research results from a series of expenditure models reported in this paper bring more information to bear on the problem than has previously been available. These results suggest that if recent trends in the determinants of the age and employment characteristics of Alaska's population remain unchanged into the future, there is a very good chance of substantially cutting expenditure growth rates in several areas.

DESCRIPTION OF THE EXPENDITURE MODELS

The purpose of the expenditure models developed under MAP is to (1) provide a general or preliminary assessment of the sensitivity of the state's operating budget to a variety of projections concerning the state's economic development and (2) to demonstrate the overall effect of a series of fiscal policies, such as: increasing per capita spending on key programs, adopting specific restricted growth rules for the state budget, and eliminating certain programs. The models allow the researcher to trace out the possible implications of cutting some programs while expanding others and thus provide some general guidance for fiscal planning. Finally, the models have some use in impact assessment, since they can be used to highlight which programs could be most heavily influenced by future development if past demographic patterns are either repeated or altered in selected ways.

The operating budget of the State of Alaska is organized into a series of program categories, which are further subdivided into cover programs and budget request units (BRUs). The program categories correspond to major governmental purposes or functions of the state, such as education and social services. The cover programs are the major subunits of the program categories. For example, education breaks down into primary and secondary education; adult and postsecondary education; and education, information, and cultural services. Budget request units correspond to individual programs or small groups of closely related programs. Program categories and cover programs are oriented toward program purpose or programmatic impact rather than administering agency. For example, "Social and Economic Assistance for the Aged" cover program in the 1979 budget contains eight

BRUs assigned to five agencies and is, in turn, part of the Social Services program, which contains programs administered for various purposes by eight agencies. The expenditure models follow a similar organization (Table 1).

A model has been constructed for each program category, and each model produces estimates of future expenditures for each cover program under three different conditions. The first of these projections is based on past relationships between the level of expenditures for the program category and the size of some demographic determinant such as the projected number of children enrolled in school or the number of persons of working age in the economy. The second projection uses an estimated relationship between expenditures for the program category and total operating expenditures for all purposes. The third projection estimates a constant real per capita expenditure for the population assumed to be the primary users of the services provided by the specified cover program. Each projection gives a different perspective on the significance of past trends or past determinants of expenditures. While not a forecast of future expenditures, for example, the demographically determined projection reveals the combined future fiscal influence of the trend in the level of expenditures per person and the growth of a broadly defined group of beneficiaries for each individual cover program within each program category. It thus permits the highlighting or identification of possible "problem areas" in the budget which may be growing especially rapidly and contributing to budget increases. It also provides some feel for the future consequences of not changing past trends in services for individual categories of expenditure. The second type of projection, "past trends against total expenditures," provides information on the current direction of expenditures for individual cover programs compared to the budget as a whole and can be used to reveal how a simple expenditure rule applied proportionately to all program categories might affect per capita expenditures for each cover program and its constituency. If the first type of projection can be viewed as a sort of "demand for expenditures" type of projection, the second is more useful in analyzing simple types of "supply" constraints applied to the budget as a whole. The third type of projection has a couple of interesting uses. When the level of real spending is set at the current level, the projection measures the future effects of population growth and demographic change on the operating budget, independent of changes in the real level of services as measured by expenditures. The level of real spending can be changed in the model for any program category or group of program categories, however, to estimate the effect either of changing the level of services to be provided, or to measure the effect of efficiency gains which would tend to lower the unit costs of services. Finally, the difference between the first and third types of projections provides an estimate of the budetary effect of increased levels of service

Table 1

Organization of State Government Programs in MAP Expenditure Planning Model

Program Category	Cover Programs
Education:	Primary and Secondary Education Vocational Education University of Alaska Miscellaneous and Community Education Services
Social Services:	Services to the Aged Employment Stabilization Services Other Social Services, Except Administration Administration
Health:	Public Health Medical Assistance (Financial Aid) Mental Health Planning and Administration
Natural Resources and Environmental Protection:	Commercial Fishing Sport Fishing and Hunting Parks and Recreation Other
Public Protection:	Consumer Protection Protection of Life and Property (Except Police) Worker Protection (Occupational Safety)
Administration of Justice:	Police Protection Due Process Worker Protection (Wages and Hours, Workman's Compensation, Local Hire) Prisoner Confinement Administration and Planning
Development:	Economic Development Revenue Sharing Other Local and Community Development
Transportation:	Highways Maintenance and Operation Marine Highway System Airports Maintenance and Operation Engineering, Administration, Planning
General Government:	No Separate Cover Programs

(not adjusted for efficiency gains) and constant levels of service (either adjusted or not adjusted for efficiency gains).

Both in the interest of brevity and simplicity of presentation and because only a tentative specification is available at this time, a complete description of each model does not appear in this paper. However, a general schematic diagram is shown in Figure 1. The demographic projections required to run the model can be derived from any source. In the following cases, the projections were provided by a run of the MAP econometric model, which has a population model attached and integrated into the modeling framework. State total expenditures for the second, or trend, projections were estimated using a simple expenditure rule and state revenues generated by the fiscal component of the MAP econometric model. When used with the MAP econometric model, the expenditure models provide a perspective on the government services which would be delivered by a given level of state expenditures consistent with projections of future state revenues.

GROWTH IN STATE EXPENDITURES, 1978-2000

To provide the reader with a feeling for how the expenditure models can be used to plan for state government services in the context of vastly expanded temporary oil wealth, and to place the future in the perspective of recent experience with Alaska budgets, I have set out in the first section of Table 2 the historical rates of growth of real per capita state expenditures for the last 15 fiscal years. These are divided into eight major program categories[2] for the period before the Prudhoe Bay lease sale (1963-69), and after the sale (1970-77). Because the $900 million provided in Prudhoe Bay lease bonuses in the fall of 1969 resulted in a rapid upward adjustment in state spending in FY 1970-1972, I have also shown the more "normal" post-sale period, 1972-1977. As can be seen from the table, the rate of increase was quite rapid in nearly all categories.

In the future, state expenditures will help determine the rate of growth, but the growth process itself will create additional demand for government services. In the second and third sections of the table, I have set forth a hypothetical example of "demand" for state expenditures in a rapid growth case. In this case, the state legislature, encouraged by royalty and severance tax revenues from Prudhoe Bay, allows total state government real per capita spending to rise at 9.8 percent per year, between 1976 and 1985, or at about 50 percent above the 1970-1977 rate. In 1985, the per capita budget growth process is stopped, but population continues to grow

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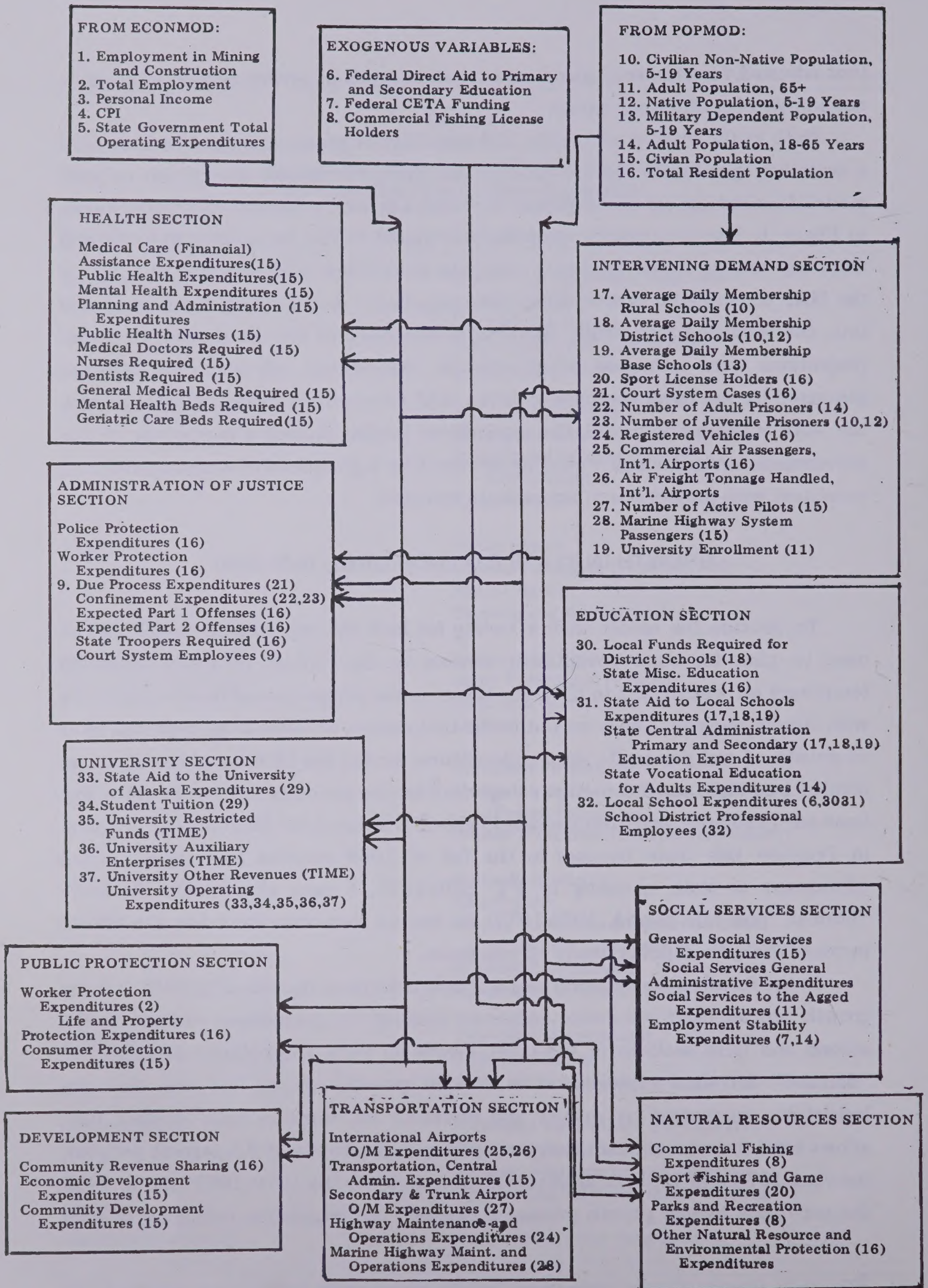
[2] **The ninth category, General Government, has also grown rapidly, but because it provides mostly legislative, general administrative, and intragovernmental services, I have ignored it for this paper.**

Figure 1. MAP State Expenditure Models


FROM ECONMOD:
1. Employment in Mining and Construction
2. Total Employment
3. Personal Income
4. CPI
5. State Government Total Operating Expenditures
EXOGENOUS VARIABLES:
6. Federal Direct Aid to Primary and Secondary Education
7. Federal CETA Funding
8. Commercial Fishing License Holders
FROM POPMOD:
10. Civilian Non-Native Population, 5-19 Years
11. Adult Population, 65+
12. Native Population, 5-19 Years
13. Military Dependent Population, 5-19 Years
14. Adult Population, 18-65 Years
15. Civian Population
16. Total Resident Population
HEALTH SECTION
Medical Care (Financial) Assistance Expenditures(15)
Public Health Expenditures(15)
Mental Health Expenditures (15)
Planning and Administration (15) Expenditures
Public Health Nurses (15)
Medical Doctors Required (15)
Nurses Required (15)
Dentists Required (15)
General Medical Beds Required (15)
Mental Health Beds Required (15)
Geriatric Care Beds Required(15)
INTERVENING DEMAND SECTION
17. Average Daily Membership Rural Schools (10)
18. Average Daily Membership District Schools (10,12)
19. Average Daily Membership Base Schools (13)
20. Sport License Holders (16)
21. Court System Cases (16)
22. Number of Adult Prisoners (14)
23. Number of Juvenile Prisoners (10,12)
24. Registered Vehicles (16)
25. Commercial Air Passengers, Int'l. Airports (16)
26. Air Freight Tonnage Handled, Int'l. Airports
27. Number of Active Pilots (15)
28. Marine Highway System Passengers (15)
19. University Enrollment (11)
ADMINISTRATION OF JUSTICE SECTION
Police Protection Expenditures (16)
Worker Protection Expenditures (16)
9. Due Process Expenditures (21)
Confinement Expenditures (22,23)
Expected Part 1 Offenses (16)
Expected Part 2 Offenses (16)
State Troopers Required (16)
Court System Employees (9)
EDUCATION SECTION
30. Local Funds Required for District Schools (18)
State Misc. Education Expenditures (16)
31. State Aid to Local Schools Expenditures (17,18,19)
State Central Administration Primary and Secondary (17,18,19) Education Expenditures
State Vocational Education for Adults Expenditures (14)
32. Local School Expenditures (6,3031)
School District Professional Employees (32)
UNIVERSITY SECTION
33. State Aid to the University of Alaska Expenditures (29)
34. Student Tuition (29)
35. University Restricted Funds (TIME)
36. University Auxiliary Enterprises (TIME)
37. University Other Revenues (TIME)
University Operating Expenditures (33,34,35,36,37)
SOCIAL SERVICES SECTION
General Social Services Expenditures (15)
Social Services General Administrative Expenditures
Social Services to the Agged Expenditures (11)
Employment Stability Expenditures (7,14)
PUBLIC PROTECTION SECTION
Worker Protection Expenditures (2)
Life and Property Protection Expenditures (16)
Consumer Protection Expenditures (15)
DEVELOPMENT SECTION
Community Revenue Sharing (16)
Economic Development Expenditures (15)
Community Development Expenditures (15)
TRANSPORTATION SECTION
International Airports O/M Expenditures (25,26)
Transportation, Central Admin. Expenditures (15)
Secondary & Trunk Airport O/M Expenditures (27)
Highway Maintenance and Operations Expenditures (24)
Marine Highway Maint. and Operations Expenditures (28)
NATURAL RESOURCES SECTION
Commercial Fishing Expenditures (8)
Sport Fishing and Game Expenditures (20)
Parks and Recreation Expenditures (8)
Other Natural Resource and Environmental Protection (16) Expenditures

Key:

= Links Between Models

Number Before Variable = Number of variable used in a link to another section. If it is not numbered, the variable is not used in a link.

Number in Parentheses = Number of a variable used to determine this variable in a model link.

Note: CPI appears in all expenditure equations as a deflator. Total operating expenditures appear in all equations determining expenditures from the trend against the total. They have been omitted for simplicity.

Table 2

Rates of Growth in Real Per Capita State Expenditures by Program Category, Selected Periods

Case 1

	Education (%)	Social Services (%)	Health (%)	Natural Resources (%)	Public Protection (%)	Administration of Justice (%)	Development (%)	Transportation (%)
Historic Rates:								
1963-69	NA	10.4	-0.6	2.9	16.5	8.4	9.5	7.7
1970-77[a]	9.0	10.8	12.7	7.7	15.6	10.7	11.7	4.9
1972-77[a]	1.4	3.2	9.9	3.8	16.3	8.3	7.0	2.2
Business as Usual, Implicit Demand:								
1976-1985	2.8	9.8	2.5	7.2[b]	5.0	2.5	2.6	5.1
1985-2000	5.2	6.9	3.0	13.2[b]	6.3	3.9	3.1	4.0
Demographic Influence Only, Implicit Demand:								
1976-1985	0.9	2.0	0.9	0.7	0.7	0.7	0.8	1.1
1985-2000	2.4	2.7	1.6	1.4	1.4	1.5	1.5	1.6

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[a] No data was available on the 1977 University of Alaska expenditures for this function. 1970-76 and 1972-76 rates were used.

[b] Large increases in Natural Resources spending are projected because of state spending in support of commercial fishing, to sustain a rate of growth of approximately six percent per year to the end of the century consistent with the state's fishery rehabilitation plan.

because of cumulative effects. The simulated pattern of state government revenues and expenditures and state population is shown in Figure 2 for this case. In spite of the state being able to put the brakes on state spending after 1985, the expenditure models' estimate that implicit "demand" for government spending (implied by demographic changes and trends in expenditures on specific segments of the population) continues to grow in real per capita terms, even after 1985; demographic factors alone account for about one-fourth to one-half of the increase after 1985. If this case described reality, then between 1976 and 1985 the state would be increasing the real level of public expenditures at about twice the rate justified by past increases in per capita levels for primary user groups and growth in these groups, and at up to ten times the rate justified by demographic changes alone. After 1985, if the state were to hold real spending per capita constant, only those program categories whose primary user groups were growing more slowly than the population as a whole could expect real spending gains. Obviously, a more gradual and sustained rate of increase in spending is called for in this case, which would also have a positive effect on the state's fiscal balance in the long run.

IMPACT OF A DEVELOPMENT PROJECT

An example of model use is provided by a second case in which the state encourages the building of a refinery/petrochemical complex to process its share of Prudhoe Bay crude oil.[3] Table 3 describes the demographic effect on several aspects of education category expenditures and services. The proposed project employs about 450 people in construction in 1979, rising to 3,500 in 1981. The project is completed in 1984, and operations employment is about 1,925 persons. The plant generates about $37.4 million in taxes in 1984, rising to $117.5 million in 1990, and $233.1 million by 2000. This section addresses the sort of demands which might be put on Alaska's educational system.

Table 3 shows the demographic effect on the Alaska school system under one set of assumptions. The statewide district school population is estimated to be about 8 percent (7,100 students) larger than it otherwise would have been by 1984, the year of plant completion. After the construction boom is over, the effect on the school population declines, but there is still a residual effect caused by the plant's permanent employment, associated employment, and eonomic growth caused by state and local government spending of tax revenues generated by the plant. The

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[3] The expenditure rules, the assumptions related to the project, etc., are identical to those laid out in Goldsmith and Huskey [6]. The project is the ALPETCO proposal, being negotiated between the State of Alaska and Alaska Petrochemical Company. The project is briefly described in the text.

Figure 2:

Real Per Capita
Revenues and Expenditures
and Total Population
Case 1

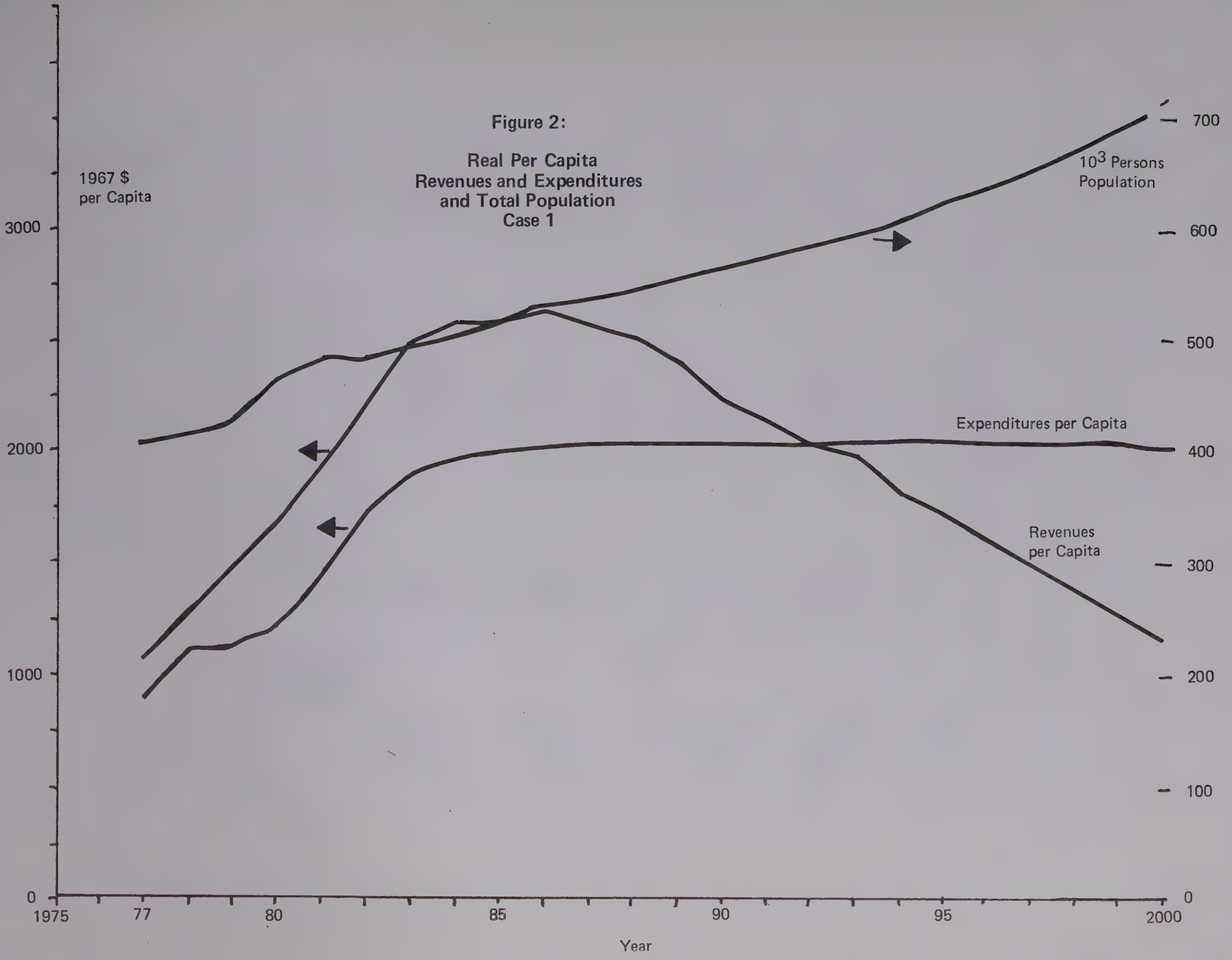

Table 3

Percent Impact of a Petrochemical Complex on Demand for Education Expenditures

Absolute Difference from Base Case:

	ADMD	EEDS96K	TXLOCK
1979	0.00000	0.379517	-0.018387
1984	7.07698	29.433100	-0.003330
1990	5.69098	27.015400	0.015477
2000	7.04504	72.263700	0.042629

	ENRU	EUAK	EEDUASK
1979	0.00000	0.158859	0.083435
1984	2.63712	11.156200	9.204670
1990	1.75880	8.953580	7.402190
2000	2.44475	36.887000	25.230500

Percent Difference from Base Case:

	ADMD	EEDS96K	TXLOCK
1979	0.00000	0.167615	-1.547330
1984	8.27317	9.506060	-0.323914
1990	5.81115	6.313140	1.733480
2000	5.49527	9.573280	6.489220

	ENRU	EUAK	EEDUASK
1979	0.00000	0.167606	0.167621
1984	9.28726	7.385660	11.234200
1990	4.70270	3.663310	5.629250
2000	3.79831	6.532510	8.146370

Key: ADMD =District School Enrollment, 10^3Students.
EEDS96K =State Aid to Local Schools, 10^6Dollars.
EEDSUASK =State Aid to the University of Alaska, 10^6Dollars.
ENRU =Head Count Enrollment, University of Alaska System, 10^3Students
EUAK =University Budget, 10^6Dollars.
TXLOCK =Local Funding for Local Schools, Divided by State Personal Income.

table also shows the estimated effect on state spending for elementary and secondary education, and the amount of money local governments statewide would have to raise if current trends in local funding were to prevail.

The long-term effect is about a 9.6 percent increase in state spending, since real spending increases have turned out historically to be more than proportional to enrollment increases, and because of higher price levels in this case. The impact is about $72 million per year (about $33.8 million in 1978 dollars) by the year 2000. There is also an impact on local government. The amount of money required to just maintain real per capita spending by local governments would, in this case, increase the implicit tax burden by the year 2000. However, during the construction period, high construction wages cause personal income growth to outstrip local expenditure increases. The impact on the variable TXLOCK does not necessarily imply increased taxes. If the burden of additional enrollment were solely distributed to the Kenai Borough, for example, where the plant is to be located, the property taxes generated by the plant ($90.3 million) far exceed the increment in expenditure demand ($16.8 million). However, if enrollment increases also appear in areas such as Anchorage, whose property taxes are not paid by the plant, some of the burden could occur in the form of increased local taxes. The alternative might be additional state aid to those school districts adversely impacted (if any).

A second set of figures in Table 3 describes some impacts on adult education. The demographic influence of total growth associated with the project could be expected to have an impact of about 3.8 percent increase in university enrollments over the long term (somewhat larger in the short run, with heavy adult migration to the state) if historic enrollment to adult population ratios prevailed. The total university budget would have to rise about 6.5 percent to maintain spending per student and to allow for normal demand growth for other university functions. In order to maintain state general fund expenditures per student at a constant level, due to the higher rate of inflation (price levels are about 4.2 percent higher) and the larger student body in the impact case, the state would have to increase nominal dollar expenditures by about 8 percent over the base case by the year 2000.

The expenditure and econometric models can be used iteratively in the following way to plan for impacts. A development project and government expenditure rule can be assumed and its consequences on the economy and the state budget estimated using the models; also, other combinations of rules can be tried which more closely meet the "demand for expenditures" requirements set forth by the expenditure models. While there is no guarantee that the process is a convergent one, it is cheaper and easier to use than either simple trial and error, or a large model with considerable (and usually expensive) simultaneity.

CONCLUSION

The experiments described in this paper have been deliberately kept brief, and sensitivity analysis avoided, since the purpose was to merely demonstrate how the expenditure models can be used in conjunction with an econometric model to highlight possible problems in future state budgets, in the context of rapid economic growth. It is anticipated that once the models have been calibrated to our satisfaction, MAP researchers will be able to use them to (1) identify possible strategies for reducing the rate of growth of state spending in Alaska, (2) test the sensitivity of outcomes to underlying assumptions, and (3) when used jointly with our econometric model, to estimate the effects of future development projects on the State of Alaska under a wider variety of circumstances than has previously been possible.

In general, in attempting to assess the impact of large-scale development in resource-rich small economies, we have found that it is not enough to identify the primary and secondary impacts of development, since the changes induced in the economy by the project are emphatically not of a marginal nature or a mere extension of past experience. In alaska, we have focused in particular on the issue that the state government spending in itself is a prime mover in the growth process, so that it is important to get as complete a picture as possible of the likely demand for state services to be provided in the long run. The models outlined here are only a first step. Future ISER research will also be directed to a more microeconomic level, attempting to estimate the influence of specific variables on key state programs. We do not know yet whether we will be able to successfully estimate production functions or consumption functions for public services in Alaska, much less whether we will be able to guess how these will change. What we do hope to do is, guided by a combination of good sense and good research, develop a set of robust fiscal policies which will help ensure Alaska's healthy fiscal future.

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